

Standardization of wet acid delinting method for cotton cv. MCU 5

K. RAJA, A.S. PONNUSWAMY, M. BHASKARAN, A. BHARATHI, K. PRABAKAR, K. VANANGAMUDI AND R. VISWANATHAN

Dept. of Seed Science and Tech., Tamil Nadu Agricultural University, Coimbatore - 641 003, Tamil Nadu

Abstract: A study was carried out to standardize wet acid delinting technique for cotton cv. MCU 5 during 2001-2002 at Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore. It was found that seed recovery, fuzz removal, delinting efficiency, mechanical damage and acidity were increased with increase in quantity of commercial sulphuric acid (H_2SO_4) and contact time (seed to acid). Test weight (100 seed weight) decreased with increase in quantity of acid and delinting time. The germination percentage and vigour index were increased with increase in acid and contact time to certain level and then started declining. The results concluded that a concentration of 100 ml of commercial sulphuric acid kg^{-1} and 4 minutes contact duration were found to be optimum for effective declining and maintaining seed quality of MCU 5 cotton.

Key words : Cotton MCU 5, Wet acid delinting, Seed quality.

Introduction

India is one of the major cotton growing countries in the world. Cotton (*Gossypium* sp.) is one of the major cash crops of India and it is being grown on about 8.6 million ha area with an annual production of 9.7 million tonnes. Good quality seed acts as a catalyst for realizing the potential of all the other inputs in Agriculture. As the plant population directly affects on the yield of the crop, it is important to have a good seed to maintain required plant population in an unit area. There is a large scope for mechanization in cotton cultivation of India. But it has been a neglected field due to limitation and difficulty in use of machineries even at initial operation like sowing. One of the limitation in the use of fuzzy cotton seed treated with cowdung and soil is the tendency of clogging in the seed chute furrow openers. For upgrading the seed quality, reduction in quantity of seed storage, preventing seed borne pathogens and insects, reduction in cost of seed processing, mechanization of sowing operation, maintaining high level of germination, plant population and better yield, it is necessary to delint the fuzzy cotton seed either by mechanical or chemical or flame methods.

Among the different methods used, acid delinting is the simplest and commonly used

in India. Acid treatment of cotton seed is known to be beneficial in controlling development of bacterial diseases (McDonald *et al.* 1939). Acid delinted seeds emerged better than the undelinted one under field conditions under wide range of temperatures. For efficient sowing with seed drills and planters and to scarify the seed, the cotton seed has to be delinted with sulphuric acid (Goyal *et al.* 1973). Vermal *et al.* (1974) observed that acid delinting with sulphuric acid was very effective in eliminating external seed borne inoculum. Javellonar *et al.* (1998) reported that delinted cotton seed maintained high germinability and vigour. Hence, a study was carried out during 2001-2002 to standardize the quantity of acid required and contact time of acid to seed in delinting of cotton cv. MCU 5.

Materials and Methods

The study was conducted during 2001-2002 in Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, India. Seeds of cotton cv. MCU 5 constituted the material for study. Seven concentrations of commercial sulphuric acid (H_2SO_4) viz. 60 to 120 ml in the increments of 10 ml and with six levels of delinting contact times viz. 2 to 12 minutes in the increments of 2 minutes were followed. The delinting of all the lots (42 lots-7 concentrations and

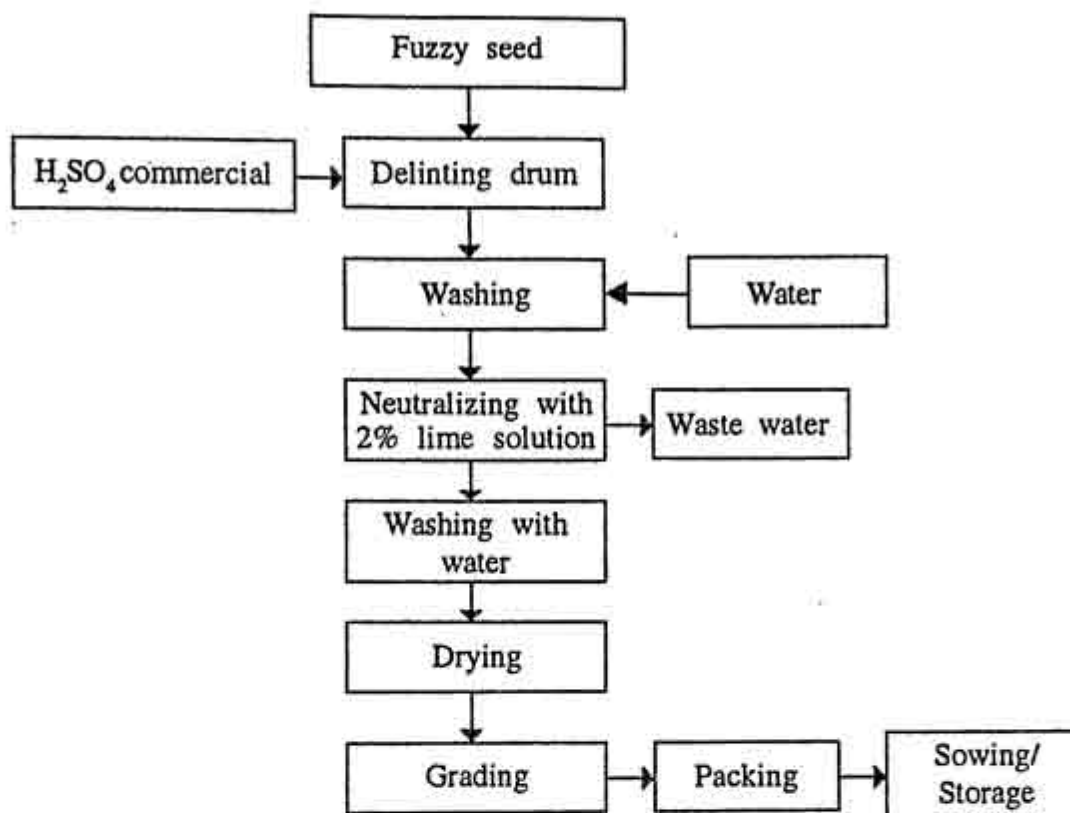
Table 1. Effect of acid delinting on recovery and fuzz removal of cotton cv. MCU 5

Quantity	Recovery (%)							Fuzz removal (%)						
	Duration (minutes)							Duration (minutes)						
	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
H ₂ SO ₄ (ml)	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
60	68.4	68.8	70.0	71.0	72.4	73.4	70.7	5.40	6.64	6.75	7.50	8.70	11.0	7.70
70	68.5	70.6	74.0	75.0	76.0	77.4	73.5	8.90	8.12	8.95	9.50	12.30	14.70	10.41
80	70.0	73.6	81.0	82.0	83.1	84.3	75.7	12.30	8.73	10.75	11.30	14.30	15.80	12.23
90	73.3	79.0	82.0	83.7	84.3	84.0	81.0	12.38	13.15	12.10	15.20	15.80	15.90	14.10
100	80.0	81.4	83.3	83.5	83.5	84.0	82.5	12.70	14.10	14.30	16.50	16.90	16.80	15.10
110	80.9	81.9	85.0	85.0	85.3	85.0	83.7	13.30	15.20	15.50	16.70	17.20	17.20	15.74
120	82.7	81.6	86.0	85.2	85.2	85.0	84.3	13.80	15.30	15.80	16.95	17.20	17.30	15.71
Mean	74.7	76.7	80.2	80.7	79.9	80.3		11.30	11.41	11.90	13.40	14.60	15.53	
CD	T		M		T x M			T		M		T x M		
(P=0.05)	0.348		0.323		0.855			0.409		0.379		1.003		

Table 2. Effect of acid delinting on delinting efficiency and mechanical damage in cotton cv. MCU 5

Quantity	Delinting efficiency (%)							Mechanical damage (%)						
	Duration (minutes)							Duration (minutes)						
	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
H ₂ SO ₄ (ml)	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
60	20	25	40	75	85	90	55.83	2.5	3.5	4.0	4.0	7.0	11.0	5.33
70	30	30	50	80	95	97	63.66	2.5	3.5	4.5	5.0	10.0	12.0	6.25
80	60	65	75	95	99.7	99	82.28	2.0	4.0	5.5	7.5	12.0	14.0	7.50
90	75	86	95	97.5	100	100	92.25	2.5	3.5	5.0	8.0	15.0	16.0	8.33
100	92.5	98.5	99.8	100	100	100	98.45	2.5	4.0	6.5	11.0	16.0	21.0	10.16
110	93.5	99.0	100	100	100	100	98.75	5.5	6.0	8.5	15.5	19.0	27.0	13.58
120	94.5	99.5	100	100	100	100	99.00	6.0	7.0	10.5	19.0	23.0	29.0	15.75
Mean	66.50	71.90	79.96	92.50	97.10	98.00		3.36	4.50	6.36	10.00	14.57	18.57	
CD	T		M		T x M			T		M		T x M		
(P=0.05)	3.75		3.47		9.19			0.913		0.845		2.24		

Fig.1. Flow diagram of wet acid delinting



6 timings) with weight of one kg each were subjected to delinting drum for delinting. The flow chart of delinting is given in Figure 1. After delinting, seeds were neutralized with 2% lime solution and given with thorough washing for 4 to 5 times using water. At the final washing, the light delinted seeds designated as floaters were removed by water floatation method and separated from heavy seeds termed as sinkers which had sunk to the bottom. The sinkers and floaters were dried to required moisture level.

Delinted seeds were evaluated for recovery percentage. The germination percentage, vigour index (Abdul-Baki and Anderson, 1973), moisture content, test mass (100 seed weight) were evaluated as per the procedure prescribed by ISTA (1999). Electrical conductivity (Presley, 1958), pH and mechanical damage (Agrawal, 1999) were also observed. The mathematical indices (Anon, 2001) of wet acid delinting were as follow.

1. Recovery percentage (RS)

Seed recovery was determined by separating the sinkers (good seed) and floaters.

$$RS\% = \frac{SW}{TW} \times 100$$

where, TW = Total mass of sample
SW = Mass of good seed (sinkers)

2. Fuzz removal (FR)

$$FR = \frac{(Cb - Ca)}{Cb}$$

Where, FR = Fuzz content of cotton seed (%)
Cb = Mass of oven dried cotton seed before delinting
Ca = Mass of oven dried cotton seed after delinting.

3. Delinting efficiency (Ed)

$$Ed = \frac{Fr}{Ft} \times 100$$

Where, Ed = Delinting efficiency, (%)
Fr = Mass of fuzz removed
Ft = Total mass of fuzz

Table 3. Effect of acid delinting on moisture content and 100 seed weight in cotton cv. MCU 5

Quantity		Moisture content (%)						100 seed weight (g)							
		Duration (minutes)						Duration (minutes)							
		2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
H ₂ SO ₄ (ml)		2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
60	12.6	12.5	12.3	12.3	12.6	12.3	12.41	9.3	9.3	9.2	9.0	8.8	8.8	8.7	9.01
70	12.7	12.4	12.5	12.7	12.5	12.5	12.49	9.1	9.2	9.1	8.8	8.5	8.5	8.5	8.86
80	12.7	12.5	12.6	12.5	12.5	12.3	12.54	9.5	9.1	8.9	8.7	8.4	8.4	8.4	8.71
90	12.3	12.8	12.7	12.3	12.7	12.6	12.52	9.1	8.9	8.8	8.8	8.4	8.4	8.4	8.74
100	12.1	12.8	12.6	12.7	12.3	12.7	12.52	8.9	8.9	8.7	8.5	8.5	8.5	8.5	8.68
110	12.3	12.3	12.4	12.5	12.5	12.6	12.41	8.95	8.9	8.6	8.6	8.4	8.5	8.5	8.65
120	12.8	12.8	12.6	12.6	12.3	12.6	12.51	8.7	8.7	8.5	8.5	8.5	8.5	8.5	8.53
Mean	12.5	12.5	12.5	12.47	12.45	12.52		9.00	8.96	8.81	8.66	8.49	8.5	8.5	
CD	T		M		T x M			T		M		T x M			
(P=0.05)	NS		NS		NS			0.1063		0.098		NS			

Table 4. Effect of acid delinting on pH and EC of delinted seed leachage in cotton cv. MCU 5

Quantity	pH							EC (dSm ⁻¹)						
	Duration (minutes)							Duration (minutes)						
	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
H ₂ SO ₄ (ml)														
60	6.29	6.31	6.29	6.05	6.10	5.50	6.10	0.935	1.134	0.974	1.120	1.064	1.044	1.040
70	6.26	6.32	6.30	6.28	6.32	5.49	6.20	0.998	0.988	0.991	0.972	1.015	1.204	1.028
80	6.16	6.12	6.09	6.01	5.94	4.84	5.86	0.995	1.093	0.995	0.925	1.055	1.009	1.109
90	6.16	6.12	6.13	6.00	6.03	3.07	5.58	0.996	1.093	0.991	0.960	0.999	1.028	1.012
100	6.01	6.04	6.06	5.89	5.62	2.89	5.40	0.948	1.144	1.013	0.930	1.154	1.009	1.032
110	6.12	5.99	5.94	5.89	5.50	2.85	5.40	1.055	1.096	0.925	1.474	1.331	1.040	1.154
120	6.12	5.89	5.79	5.88	5.50	2.80	5.30	1.059	1.096	1.212	1.519	0.955	1.100	1.156
Mean	6.20	6.10	6.10	5.98	5.86	3.92		0.998	1.092	1.015	1.730	1.100	1.061	
CD	T		M		T x M			T		M		T x M		
(P=0.05)	0.155		0.143		0.379			0.752		0.695		1.841		

Quantity	Germination (%)							DMP (g/10 seedlings)						
	Duration (minutes)							Duration (minutes)						
	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
H ₂ SO ₄ (ml)	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
60	62	62	64	68	74	74	67.50	0.394	0.432	0.374	0.374	0.394	0.402	0.391
70	62	63	66	68	70	74	67.12	0.373	0.380	0.390	0.390	0.378	0.369	0.381
80	70	66	70	75	80	81	73.70	0.418	0.416	0.371	0.375	0.371	0.370	0.388
90	70	78	82	80	82	82	79.00	0.415	0.410	0.401	0.405	0.356	0.351	0.383
100	70	85	85	86	85	83	82.70	0.470	0.528	0.443	0.443	0.412	0.375	0.399
110	71	86	80	72	70	60	73.50	0.435	0.364	0.422	0.428	0.400	0.390	0.390
120	73	81	74	71	67	57	70.50	0.468	0.364	0.383	0.384	0.365	0.331	0.386
Mean	68.30	74.50	74.40	74.30	75.21	73.30		0.421	0.403	0.376	0.388	0.374	0.364	
CD	T		M		T x M			T		M		T x M		
(P=0.05)	2.739		2.535		6.709			NS		0.0215		NS		

Table 6. Effect of acid delinting on shoot length and root length of cotton cv. MCU 5

Quantity	Shoot length (cm)							Root length (cm)						
	Duration (minutes)							Duration (minutes)						
	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
H ₂ SO ₄ (ml)	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
60	17.3	17.8	17.6	18.0	18.1	18.1	17.70	11.9	13.5	10.7	15.0	14.3	14.6	13.96
70	16.9	16.4	17.1	18.8	18.2	18.3	17.43	11.2	14.4	10.9	14.2	13.9	14.3	13.78
80	16.6	16.9	17.5	18.9	16.5	16.1	17.00	11.5	15.3	15.9	13.0	13.1	13.1	13.70
90	19.2	16.9	18.3	18.8	17.7	18.5	18.00	11.4	14.4	14.7	13.7	13.1	13.3	13.43
100	17.5	17.8	18.7	17.9	17.7	18.5	17.50	12.5	15.2	15.6	15.0	12.9	12.9	13.93
110	17.3	17.6	17.9	17.3	16.9	17.0	17.00	11.2	14.4	14.4	14.3	12.5	12.5	13.19
120	17.3	16.5	15.5	16.0	16.3	16.2	16.10	10.5	12.6	12.7	13.6	12.5	12.3	12.37
Mean	17.60	17.46	17.40	17.30	17.07	17.00		11.42	14.30	14.52	14.07	13.24	13.32	
CD	T		M		T x M			T		M		T x M		
(P=0.05)	0.402		0.370		0.984			0.356		0.330		0.873		

Table 7. Effect of acid delinting on vigour index (Germination % x DMP) of cotton cv. MCU 5

Table 7. Effect of acid demineral on Vigour index							
Quantity	Vigour index						Mean
	Duration (minutes)						
	2	4	6	8	10	12	
H ₂ SO ₄ (ml)	2	4	6	8	10	12	Mean
60	24.43	27.25	22.46	25.43	29.16	29.76	26.45
70	23.13	24.05	26.07	26.52	26.46	27.36	25.67
80	29.26	27.46	26.79	29.73	29.63	29.72	28.45
90	29.05	39.32	29.10	32.13	29.32	29.68	31.45
100	32.90	42.91	43.42	38.14	25.05	31.17	37.28
110	30.51	36.27	29.16	30.83	28.97	23.40	30.10
120	34.21	32.43	26.88	27.22	24.45	18.86	32.35
Mean	29.10	39.12	29.30	29.69	29.02	27.23	
CD (P=0.05)		T		M		T x M	
		5.83		5.400		14.290	

4. Mechanical damage (%)

$$\text{Md (\%)} = (\text{Sd} \times \text{St}) \times 100$$

Where, Md = Mechanical damaged seed (%)

Sd = Number of damaged seeds

St = Total number of seeds in the sample

The experiment was designed in completely randomized design with two replications. Statistical analysis was done by following the procedure described by Panse and Sukhatme. (1978).

Results and Discussion

In the present investigation, the seed recovery (Table 1), delinting efficiency (Table 2), fuzz removal percentage (Table 1) and mechanical damage (Table 2) were increased with increase in quantity of sulphuric acid (H₂SO₄) and delinting time for cotton cv. MCU 5. Test mass (Table 3) was decreased with increase in quantity as well as delinting time. Moisture content (Table 3) remained almost unaffected in all treatments. Acidity (Table 4) increased with advance of delinting time and quantity.

Germination percentage (Table 5) and vigour index (Table 7) increased with increase in acid quantity and delinting time to certain level and thereafter started declining. It showed that upto certain quantity time to certain level and thereafter started declining. It showed that upto certain quantity of acid and contact time,

the acid action causes removal and dissolution of the lint sticking on seed coat and further rise in acid quantity and contact time, the action cause seed coat damage and embryo death. Delinting of cotton time, the action cause seed coat damage and embryo death. Delinting of cotton with 200 ml kg⁻¹ of seed ensure complete delinting and promoted maximum germination and vigour (Joginder Singh *et al.* 1981). The sinkers registered maximum germination followed by fuzzy seeds and the rate of germination of delinted sinkers was superior to delinted floaters. Delinted sinkers had low oil and free fatty acid (Chandramohan, 1975).

It was noticed that below and above the optimum time and concentration combinations seed quality indices were reduced. There was a fall in seedling dry mass, seedling length and test weight. This might have been due to high concentration of acid and more contact time which might have caused the injury to seed and resulted in high mechanical damage. Increase in combinations of acid and time increased the acidity which reduced the germination vigour index and seedling quality. Acid residue are known to reduce germinability and vigour of cotton seed (Boyd *et al.* 1987), produce high non-viable and healthy seeds. High concentration of acid caused more injury and reduced seedling drymass and germination (Onkarsingh *et al.* 1983).

In the present study, optimum combinations of 100 ml of acid kg⁻¹ of seeds for 4 minutes delinting time were found to be superior in maintaining seed quality. Acid delinting of fuzzy seed with H₂SO₄ @ 100 ml kg⁻¹ for a duration of 3 min and @ 125 ml kg⁻¹ for 4 min was found to be optimum (Kesavan, 1986). The optimum concentration of 100ml kg⁻¹ for 5 minutes resulted in higher germination percentage and vigour (Kausal, 2001). Similar kind of results were obtained by Chitarra *et al.* (1997). Hence, it is concluded that combination of 100 ml of acid for 4 minutes of delinting time are found to be optimum in maintaining seed quality and recommended for acid delinting of cotton seed.

References

- Abdul-Baki, A.A. and Anderson, J.D. (1973). Vigour determination in soybean seed by multiple criteria. *Crop Sci.* 13: 63-633.
- Agrawal, R.L. (1999). Seed technology. Oxford and IBH publication, New Delhi, p.2.
- Anon (2001). Standardization of wet acid delinting technique for cotton seed. All India coordinated National Seed Project (crops), pp.280-292.
- Boyd, A.H., Cabrera, E.R. and Stonsaovapak, P. (1987). Effect of acid residue on germination and vigour of acid delinted cotton seeds. Proceedings 1987 short course for seedsmen, Seed Technology Laboratory, Mississippi State University, 111-119.
- Chandramohan, N. (1975). Studies on acid delinting and its influence on seed quality and storability in MCU-5 cotton (*Gossypium hirsutum* L.). M.Sc.(Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.
- Chitarra, L.G., Da, J., Machado, C., Das, M., Vieira, G.G.C. and Da.Silva, C.M. (1977). Performance of cotton (*Gossypium hirsutum* L.) seeds as a function of duration of delinting with sulphuric acid. *Ciencia e Agrotecnologia*, 21: 425-435.
- Goyal, M.R., Daya Nand and Gulati, O.P. (1973). Chemical delinting of ginned cotton seed. Paper presented at All India Co-ordinated scheme on post harvest technology at Pantnagar, Dec.20-23.
- ISTA (1999). International rules for seed testing. Seed Science and Technology. *Supplement Rules*, 23: 1-12.
- Javellonar, R.P., Ganotisi, N.D. and Cruz, R.S. (1998). Cotton seed delinting. In: Proceedings of the International Agricultural Engineering Conference, Bangkok, Thailand, December, 7-10, 1988.
- Joginder Singh, Gatoria, G.S., Sidhu, A.S. and Sandhu, S.S. (1981). Effect of acid delinting on the over wintering larvae of pink boll worm (*Pectinophora gossypiella* SAUND) in double seeds of cotton variety J. 205. *J. Res. Punjab Agric. Univ.* 18: 104-105.
- Kausal, R.T. (2001). All India coordinated National seed project (crops). Annual Report (2000-2001), pp.288-291.
- Kesavan, R. (1986). Studies on certain aspects of grading, treating and storage of cotton (*Gossypium hirsutum* L.) seed. M.Sc.(Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.
- McDonald, D., Fielding, W.L. and Ruston, D.F. (1939). Experimental methods with cotton. III. Sulphuric acid treatment of cotton seed, and its effects on germination, development and yield. *J. Agric. Sci.* 37: 291-296.
- Onkarsingh, Tomer, R.P.S., Mohindersingh and Tyagi, C.S. (1983). A note on standardization of cotton seed for germination. *Seeds and Farms*, 9: 13-14.
- Panse, V.G. and Sukhatme, P.V. (1978). Statistical methods for Agricultural Workers. ICAR, Pub., New Delhi, pp.327-340.
- Presley (1958). Relation of protoplast permeability to cotton seed viability and predisposition to seedling disease. *Pl. Dis. Repr.* 42: 852.
- Verma, J.P., Singh, R.P. and Nayak, M.L. (1974). Bacterial blight in cotton and steps for its eradication. *Cotton Development*, 4: 23-27.

(Received: October 2002; Revised: April 2003)